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# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-333003

(43)Date of publication of application : 30.11.2001

(51)Int.CI. H04B 7/08  
H01Q 3/24  
H04B 7/26  
H04B 1/713

(21)Application number : 2000-151716

(71)Applicant : CASIO COMPUT CO LTD

(22)Date of filing : 23.05.2000

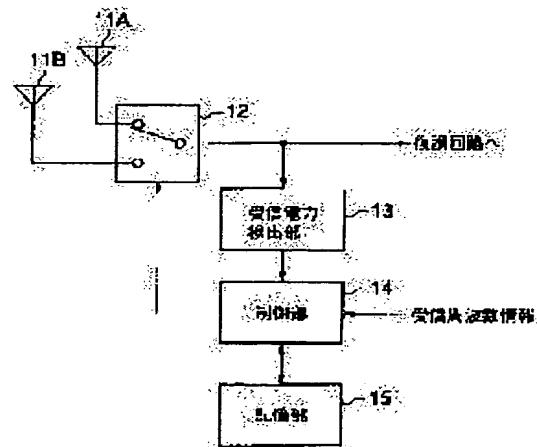
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## (54) MOBILE COMMUNICATION EQUIPMENT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide mobile communication equipment which adopts free-space diversity, is applicable even to faster data communication and receives the spread spectrum signal of a frequency hopping system.

**SOLUTION:** This equipment is provided with a plurality of antennas 11A and 11B and a control part 14 which receives a spread spectrum signal in a full frequency subjected to frequency hopping with the respective antennas, also measures its electric field intensity and stores the electric field intensity in a storing part 15, divides a full frequency band subjected to the frequency hopping into a plurality of bands, selects and decides either of the plurality of antennas 11A and 11B for each divided frequency band on the basis of the electric field intensity stored in the part 15 and makes an incoming signal received by either of the antennas 11A and 11B selected in accordance with the frequency of the incoming signal.



## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's  
decision of rejection]

[Date of extinction of right]

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CLAIMS

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## [Claim(s)]

[Claim 1] A migration communication device which is characterized by providing the following and which receives a spread-spectrum signal of a frequency-hopping method Two or more antennas A preliminary receiving means to measure the field strength while receiving a spread-spectrum signal in the perimeter wave number by which frequency hopping was carried out [ above-mentioned ] with each antenna of these plurality A decision means which divides a perimeter wave number band by the above-mentioned frequency hopping into plurality, and makes a selection judgment of either of two or more above-mentioned antennas based on divided field strength which was measured with the above-mentioned preliminary receiving means for every frequency band An antenna means for switching made to receive with an antenna which chose an arrival signal corresponding to that frequency based on a decision result in this decision means

[Claim 2] A migration communication device which is characterized by providing the following and which receives a spread-spectrum signal of a frequency-hopping method Two or more antennas A preliminary receiving means to measure the field strength while receiving a spread-spectrum signal in the perimeter wave number by which frequency hopping was carried out [ above-mentioned ] with each antenna of these plurality A decision means which makes a selection judgment of the antenna which had more numbers with which field strength exceeding a predetermined threshold among the perimeter wave number was obtained by reception with this preliminary receiving means An antenna means for switching which makes an arrival signal receive with an antenna chosen based on a decision result in this decision means

[Claim 3] The above-mentioned decision means is a migration communication device according to claim 2 characterized by making a selection judgment of the antenna with a more sufficient receive state using two or more steps of thresholds.

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[Translation done.]

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[The technical field to which invention belongs] Especially this invention relates to migration communication devices, such as a cellular phone which receives the spread-spectrum signal of a frequency-hopping method.

#### [0002]

[Description of the Prior Art] Conventionally, two or more antennas are switched alternatively and there is a diver city space method which performs the communication link using an antenna with a more sufficient communication link condition. This space diver city method is the technology which meant the cure against phasing of a narrow-band transmission system, it carries out the monitor of the received power of two or more antennas, and by switching an antenna, when less than a threshold with received power, it operates so that an antenna with received power big relative more may always be chosen. There are methods, such as switch – and – stay, and switch – and – IGUZAMIN, among the fundamental change methods, and amelioration of many of \*\*, such as making the above-mentioned threshold adjustable, is made.

#### [0003]

[Problem(s) to be Solved by the Invention] As mentioned above, since a space diver city method is the technology which meant the cure against phasing of a narrow-band transmission system, it should just switch an antenna only in consideration of fluctuation of the received power in 1 specific frequency, but when this is used for a broad-band transmission system like frequency hopping as it is, it cannot necessarily perform good reception.

[0004] Since the frequency of the electric wave received before and after switching an antenna by the frequency-hopping method differs, this is because fluctuation of the field strength of the frequency before a change differs from this fluctuation after a change.

[0005] Drawing 6 (A) shows the situation of frequency hop in the frequency / time amount / power space in a frequency-hopping method. As shown in this drawing (A), the frequency of the coming electric wave differs for every time amount, and usually carries out the hopping of the one frequency once by one sequence, without overlapping.

[0006] The frequency range of the arrival electric wave which it is drawing 6 (B) which was seen at right angles to a frequency-power side as an arrow head V shows, and can take this drawing 6 (A) by frequency hopping is shown.

[0007] Therefore, field strength before and behind a change is measured, respectively, and whenever it hops frequency based on the measurement result, an antenna with high field strength is chosen and it must be made switch an antenna in all the frequency that hops and to have to switch on each of that frequency, in order for a frequency-hopping method to perform the antenna change by the space diver city.

[0008] Therefore, the change of an antenna took time amount and there was fault that it could not apply in high-speed data communication.

[0009] This invention was made in view of the above actual condition, and the place made into the purpose is to offer the migration communication device applicable also to more nearly high-speed data communication which adopted the space diver city and which receives the spread-

spectrum signal of a frequency-hopping method.

[0010]

[Means for Solving the Problem] In a migration communication device with which invention according to claim 1 receives a spread-spectrum signal of a frequency-hopping method While receiving a spread-spectrum signal in the perimeter wave number by which frequency hopping was carried out [ above-mentioned ] with two or more antennas and each antenna of these plurality A preliminary receiving means to measure the field strength, and a perimeter wave number band by the above-mentioned frequency hopping are divided into plurality. A decision means which makes a selection judgment of either of two or more above-mentioned antennas based on divided field strength which was measured with the above-mentioned preliminary receiving means for every frequency band, It is characterized by providing an antenna means for switching made to receive with an antenna which chose an arrival signal corresponding to that frequency based on a decision result in this decision means.

[0011] A good antenna of a receive state can be chosen and a space diver city can be made to receive in a migration communication device which receives a spread-spectrum signal of a frequency-hopping method which is a transmission system covering such a configuration, then a broadband in addition to a frequency-hopping method having the frequency diver city effect primarily, corresponding to the propagation path property of two or more antennas of each, lessening change over actuation of an antenna more, and enabling application also to as high-speed data communication as possible.

[0012] In a migration communication device with which invention according to claim 2 receives a spread-spectrum signal of a frequency-hopping method While receiving a spread-spectrum signal in the perimeter wave number by which frequency hopping was carried out [ above-mentioned ] with two or more antennas and each antenna of these plurality By reception with a preliminary receiving means to measure that field strength, and this preliminary receiving means It is characterized by providing a decision means which makes a selection judgment of the antenna which had more numbers with which field strength exceeding a predetermined threshold was obtained, and an antenna means for switching which makes an arrival signal receive with an antenna which chose based on a decision result in this decision means among the perimeter wave number.

[0013] A good antenna of a receive state can be chosen and a space diver city can be made to receive in a migration communication device which receives a spread-spectrum signal of a frequency-hopping method which is a transmission system covering such a configuration, then a broadband in addition to a frequency-hopping method having the frequency diver city effect primarily, corresponding to the propagation path property of two or more antennas of each, lessening change over actuation of an antenna more, and enabling application also to more nearly high-speed data communication.

[0014] Invention according to claim 3 is characterized by the above-mentioned decision means making a selection judgment of the antenna with a more sufficient receive state using two or more steps of thresholds in invention of the claim 2 above-mentioned publication.

[0015] In addition to an operation of invention of such a configuration, then the claim 2 above-mentioned publication, by the method of a setup of a threshold, if a communication link is possible at worst, when good, or when you want to be more high-definition and to communicate a signal with few noises, optimal communication environment according to required level can be set up.

[0016]

[Embodiment of the Invention] (Gestalt of the 1st operation) It is Bluetooth (wireless LAN technology based on an IEEE802.11 standard.) about following this invention. The gestalt of the 1st operation at the time of applying to the receiving set which receives the spread-spectrum signal of the frequency-hopping method based for calling it "Bluetooth" below is explained with reference to a drawing.

[0017] Drawing 1 shows a part of circuitry of the receiving system, and 11A and 11B are two antennas for a space diver city. Only the either is chosen by the change over section 12, the signal of the ISM (Industrial Scientific Medical) band of 2.45 [MHz] which received with these

antennas 11A and 11B, respectively is sent to the circuit of the recovery system which is not illustrated here, and while processing of the back diffusion of electrons etc. is performed and gets over, it is sent also to the received-power detecting element 13.

[0018] This received-power detecting element 13 detects the field strength of the input signal in the antennas 11A or 11B sent through the change over section 12 as a value of power level, and outputs a detection result to a control section 14.

[0019] It is what a control section 14 consists of RAM as ROM which memorized CPU and its program of operation, and work memory etc., and manages the motion control of this whole receiving set. Send out the control signal which makes change over selection of either of the antennas 11A and 11B to the above-mentioned change over section 12, and also The antenna which should be chosen based on the contents which made the received frequency information and the pair which show the hopping frequency to which the power level of the input signal received from the received-power detecting element 13 is sent from the circuit of the above-mentioned recovery system, the storage section 15 was made to memorize, and this storage section 15 was made to memorize is judged.

[0020] Next, actuation of the gestalt of the above-mentioned implementation is explained.

[0021] Drawing 2 shows the contents of processing of operation of the space diver city performed by the control section 14 for every predetermined time. The signal for hopping frequency 1 sequence (79 channel frequency of the hopping width of face 1 [MHz]) be make to receive continuously at the time of processing, where change over selection of the antenna 11A be first make in the change over section 12, power level of the input signal obtain by the received power detecting element 13, respectively be make into the received frequency information and pair, and the storage section 15 be make to memorize as a receiving property in antenna 11A in this drawing (step A01).

[0022] Next, the signal for hopping frequency 1 sequence is made to receive continuously similarly, where change over selection of the antenna 11B is made in the change over section 12, power level of the input signal obtained by the received-power detecting element 13, respectively is made into the received frequency information and pair, and the storage section 15 is made to memorize as a receiving property in antenna 11B shortly (step A02).

[0023] It seems to show the power level of each received signal in drawing 3 (3), when drawing 3 (1) illustrates the propagation path property of expressing the receiving environment of the above-mentioned antenna 11A and receives the signal for one sequence in such a propagation path property.

[0024] It seems similarly, to show the power level of each received signal in drawing 3 (4), when drawing 3 (2) illustrates the propagation path property of expressing the receiving environment of the above-mentioned antenna 11B and receives the signal for one sequence in such a propagation path property.

[0025] Here, if the frequency range over one sequence of hopping frequency shall be divided into three blocks (frequency band) equally [ abbreviation ], for example as shown in drawing 3 (3) and (4) above -- carrying out -- two antennas 11A and 11B, after performing level detection of the input signal crossed to each perimeter wave number range The comparative judgment of any are relatively higher between the power level of the signal received by antenna 11A in (step A03) and its block 1 after substituting initial value "1" for the variable n with which a block is expressed first, and the power level of the signal received by antenna 11B is carried out (step A04).

[0026] When the power level of the signal received by antenna 11A judges relatively that it is high as compared with the power level of the signal received by antenna 11B, the direction of antenna 11A makes the storage section 15 carry out a storage setup of the recognition signal which shows antenna 11A as what has a good receive state corresponding to block 1 about this block 1 here (step A05).

[0027] Moreover, when the power level of the signal received by antenna 11B judges relatively that it is high on the contrary as compared with the power level of the signal received by antenna 11A, the direction of antenna 11B makes the storage section 15 carry out a storage setup of the recognition signal which shows antenna 11B as what has a good receive state

corresponding to block 1 about this block 1 (step A06).

[0028] In this way, after ending one setting processing of steps A05 and A06, A renewal setup of the value of the variable n showing a block of "+1" is carried out (step A07). After checking that the value which carried out an updating setup is not over the total N of a block (frequency band) which divided the frequency range over one sequence of hopping frequency, the processing from step S04 is again repeated using (step A08) and this variable n that carried out an updating setup.

[0029] In this way, by repeating and performing processing of steps A04-A08, a storage setup of the information which identifies the antenna of the direction with a sufficient nearby receive state about the block which remains is carried out at the storage section 15.

[0030] And if it judges that the value of the variable n which finished the setting processing about all divided blocks, and carried out an updating setup further in step A08 is over the total N of a block A control signal is transmitted to the change over section 12 as occasion demands so that change over selection of the antenna corresponding to hopping frequency may be made according to the block which carried out a storage setup after that at the storage section 15, and the identification information of an antenna. Choosing the good antenna of a receive state with every block, and performing reception (step A09) When it stands by (step A10) and judges that it passed that time amount passes as the antenna change based on the identification information of the antenna set as this storage section 15 is performed, it returns to processing from the above-mentioned step A01 again.

[0031] thus, two antennas 11A and 11B, since it was made to make change over selection of the antenna which corresponded to each propagation path property and was suitable for every block of the divided frequency band Since there are many possibilities of resembling the propagation path property of an antenna closely comparatively if it is in the block of the same frequency band, Becoming possible to lessen actuation of a change of an antenna and corresponding also to more nearly high-speed data communication, even if it compares, when performing transfer operation for every frequency, the good antenna of a receive state can be chosen and it can be made to receive.

[0032] In addition, in the gestalt of this operation, although the number of the blocks (frequency band) which divide all the bands of hopping frequency shall be 3 in order to give explanation easy, this invention can be suitably set up according to the step size of hopping frequency, the number of perimeter wave number channels, etc., without restricting to this.

[0033] (Gestalt of the 2nd operation) The gestalt of the 2nd operation at the time of applying to the receiving set which receives the spread-spectrum signal of the frequency-hopping method based on Bluetooth in this invention below is explained with reference to a drawing.

[0034] In addition, about the circuitry of a fundamental receiving system, the illustration and explanation are omitted into the same portion, using the same sign as what was shown by above-mentioned drawing 1 , and same thing.

[0035] Next, actuation of the gestalt of the above-mentioned implementation is explained.

[0036] Drawing 4 shows the contents of processing of operation of the space diver city performed by the control section 14 for every predetermined time. The signal for hopping frequency 1 sequence (79 channel frequency of the hopping width of face 1 [MHz]) be make to receive continuously at the time of processing, where change over selection of the antenna 11A be first make in the change over section 12, power level of the input signal obtain by the received power detecting element 13, respectively be make into the received frequency information and pair, and the storage section 15 be make to memorize as a receiving property in antenna 11A in this drawing (step B01).

[0037] Next, the signal for hopping frequency 1 sequence is made to receive continuously similarly, where change over selection of the antenna 11B is made in the change over section 12, power level of the input signal obtained by the received-power detecting element 13, respectively is made into the received frequency information and pair, and the storage section 15 is made to memorize as a receiving property in antenna 11B shortly (step B02).

[0038] It seems to show the power level of each received signal in drawing 5 (3), when drawing 5 (1) illustrates the propagation path property of expressing the receiving environment of the

above-mentioned antenna 11A and receives the signal for one sequence in such a propagation path property.

[0039] It seems similarly, to show the power level of each received signal in drawing 5 (4), when drawing 5 (2) illustrates the propagation path property of expressing the receiving environment of the above-mentioned antenna 11B and receives the signal for one sequence in such a propagation path property.

[0040] Here, supposing the threshold of the power level of the received signal seems for Th to show in drawing 5 (3) and (4), it turns out that the power level is less than the above-mentioned threshold Th on the channel frequency of two pieces among the signals for one sequence which received especially by antenna 11A.

[0041] However, each of the signal for one sequence which received by antenna 11A in the control section 14, and this signal received by antenna 11B is received. It is what there is a thing beyond the above-mentioned threshold Th how many, or measures the number (step B03). Based on the measurement result, it judges by whether there are more numbers which exceeded the above-mentioned threshold Th by the input signal which received whether any of a receive state of two antennas 11A and 11B would be more good for example, by antenna 11A than the same number received by antenna 11B (step B04).

[0042] Here, when it is judged that there are more numbers which exceeded the above-mentioned threshold Th by the input signal which received by antenna 11A, the direction of antenna 11A shall send out a control signal to the change over section 12 as what has a good receive state, and shall choose this antenna 11A from antenna 11B.

[0043] When it is judged that there are more numbers which exceeded the above-mentioned threshold Th on the contrary by the input signal which received by antenna 11B, the direction of antenna 11B shall send out a control signal to the change over section 12 as what has a good receive state, and shall choose this antenna 11B from antenna 11A.

[0044] A deer is carried out, and when it stands by (step B08) and judges that that predetermined time amount passes passed, performing reception by the antenna with a more sufficient receive state using the antennas 11A or 11B chosen at the above-mentioned steps B05 or B06 (step B07), it returns to processing from the above-mentioned step B01 again.

[0045] thus, two antennas 11A and 11B -- it corresponds to each propagation path property, and suppressing the change setting-operation of an antenna as much as possible, and corresponding also to more nearly high-speed data communication, since it was made to make change over selection of the antenna which can receive more signals of power level which exceeds the threshold Th set up beforehand, the good antenna of a receive state can be chosen and it can be made to receive

[0046] In addition, although the gestalt of the above-mentioned implementation explained the threshold set up beforehand as that whose number is one, this invention sets up beforehand not only this but two or more steps of thresholds, for example, is more as highly defined as the level which can communicate at worst, and becomes possible [ also offering the optimal communication environment according to the contents of the signal which sets up two or more level, such as level which wants to send and receive a signal with few noises, and is sent and received ].

[0047] Moreover, although it explained as what has two antennas 11A and 11B since a space diver city system was constituted from a configuration above-mentioned drawing 1 showed by carrying out, this may not be restricted to two, either and you may be 3 or more than it.

[0048] Furthermore, although the case where each gestalt of the 1st and operation of the 2nd of this invention is applied to the receiving set which receives the spread-spectrum signal of the frequency-hopping method based on Bluetooth is explained, if it seems that a space diver city method is built with two or more antennas, of course [ this invention is the mobile communication device which receives the spread-spectrum signal of a frequency-hopping method, without restricting to this, and ], it can apply to all.

[0049] In addition, let this invention be what has possible deforming variously and carrying out within limits which do not deviate from the summary.

[0050]

[Effect of the Invention] It corresponds to the propagation path property of two or more antennas of each, and though application also to more nearly high-speed data communication is possible, the good antenna of a receive state can be chosen and it can be made to receive by lessening change over actuation of an antenna more in the migration communication device which receives the spread-spectrum signal of the frequency-hopping method which is a transmission system covering a broadband according to invention according to claim 1.

[0051] It corresponds to the propagation path property of two or more antennas of each, and though application also to more nearly high-speed data communication is possible, the good antenna of a receive state can be chosen and it can be made to receive by lessening change over actuation of an antenna more in the migration communication device which receives the spread-spectrum signal of the frequency-hopping method which is a transmission system covering a broadband according to invention according to claim 2.

[0052] According to invention according to claim 3, in addition to the effect of the invention of the claim 2 above-mentioned publication, if the communication link is possible at worst, when good, or when you want to be more high-definition and to communicate a signal with few noises, the optimal communication environment according to required level can be set up by the method of a setup of a threshold.

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[Translation done.]

(19) 日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号  
特開2001-333003  
(P2001-333003A)

(43)公開日 平成13年11月30日(2001.11.30)

(51) Int.Cl.  
H 04 B 7/08  
H 01 Q 3/24  
H 04 B 7/26  
1/713

### 識別記号

|         |       |
|---------|-------|
| F I     |       |
| H 0 4 B | 7/08  |
| H 0 1 Q | 3/24  |
| H 0 4 B | 7/26  |
| H 0 4 J | 13/00 |

テ-マコ-ト(参考)  
5J021  
5K022  
5K059  
5K067

審査請求 未請求 請求項の数3 OL (全 8 頁)

(21)出願番号 特願2000-151716(P2000-151716)  
(22)出願日 平成12年5月23日(2000.5.23)

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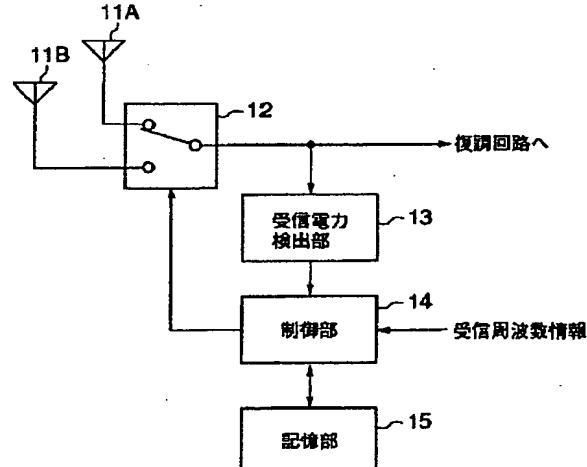
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(54) 【発明の名称】 移動通信装置

(57) 【要約】

【課題】空間ダイバシティを採用した、より高速なデータ通信にも適用可能な、周波数ホッピング方式のスペクトル拡散信号を受信する。

【解決手段】複数のアンテナ11A, 11Bと、これらアンテナ夫々により周波数ホッピングされた全周波数でのスペクトル拡散信号を受信すると共に、その電界強度を測定して記憶部15に記憶し、上記周波数ホッピングによる全周波数帯域を複数に分割し、分割した周波数帯域毎に上記記憶部15に記憶した電界強度に基づいて複数のアンテナ11A, 11Bのいずれかを選択判断し、到来信号をその周波数に対応して選択したアンテナ11A, 11Bのいずれかで受信させる制御部14とを備える。



## 【特許請求の範囲】

【請求項1】周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、

複数のアンテナと、

これら複数のアンテナそれぞれにより上記周波数ホッピングされた全周波数でのスペクトル拡散信号を受信すると共に、その電界強度を測定する予備受信手段と、上記周波数ホッピングによる全周波数帯域を複数に分割し、分割した周波数帯域毎に上記予備受信手段で測定した電界強度に基づいて上記複数のアンテナのいずれかを選択判断する判断手段と、

この判断手段での判断結果に基づき、到来信号をその周波数に対応して選択したアンテナで受信させるアンテナ切換手段とを具備したことを特徴とする移動通信装置。

【請求項2】周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、

複数のアンテナと、

これら複数のアンテナそれぞれにより上記周波数ホッピングされた全周波数でのスペクトル拡散信号を受信すると共に、その電界強度を測定する予備受信手段と、この予備受信手段での受信により、全周波数中、所定の閾値を上回る電界強度が得られた数がより多かったアンテナを選択判断する判断手段と、

この判断手段での判断結果に基づいて選択したアンテナで到来信号を受信させるアンテナ切換手段とを具備したこととする移動通信装置。

【請求項3】上記判断手段は、複数段階の閾値を用いてより受信状態のよいアンテナを選択判断することを特徴とする請求項2記載の移動通信装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、特に周波数ホッピング方式のスペクトル拡散信号を受信する携帯電話等の移動通信装置に関する。

【0002】

【従来の技術】従来、複数のアンテナを選択的に切換えて、より通信状態のよいアンテナを用いた通信を行なうダイバシティ空間方式がある。この空間ダイバシティ方式は、狭帯域伝送方式のフェージング対策を意図した技術であり、複数のアンテナの受信電力をモニタし、受信電力がある閾値を下回った場合にアンテナを切換えることで、相対的により受信電力の大きなアンテナを常時選択するように動作するものである。基本的な切換え方式には、スイッチ・アンド・ステイ、スイッチ・アンド・イグザミンなどの方式があり、また上記閾値を可変にする等々の多くの改良がなされている。

【0003】

【発明が解決しようとする課題】上述した如く空間ダイバシティ方式は、狭帯域伝送方式のフェージング対策を意図した技術であるため、特定の1周波数での受信電力

の変動のみを考慮してアンテナの切換えを行なえばよいが、これをそのまま周波数ホッピングのような広帯域伝送方式に用いた場合には、必ずしも良好な受信を行なうことができるとは限らない。

【0004】これは、周波数ホッピング方式ではアンテナを切換える前後で受信する電波の周波数が異なるため、切換え前の周波数の電界強度の変動と、切換え後の同変動とが異なるためである。

【0005】図6(A)は周波数ホッピング方式における周波数/時間/電力空間での周波数ホップの様子を示すものである。同図(A)に示すように、到来する電波の周波数は時間毎に異なり、通常は1シーケンスで1つの周波数を1回、重複せずにホッピングする。

【0006】この図6(A)を矢印Vで示すように周波数-電力面に垂直に見たものが図6(B)であり、周波数ホッピングによりとり得る到来電波の周波数範囲を示している。

【0007】したがって、周波数ホッピング方式で空間ダイバシティによるアンテナ切換えを行なうためには、ホップする周波数のすべてにおいてアンテナを切換えてそれぞれ切換え前後の電界強度の測定を行ない、その測定結果に基づいて周波数をホップする毎にその各周波数で電界強度の高いアンテナを選択して切換えるようにしなければならない。

【0008】そのため、アンテナの切換えに時間を使い、高速のデータ通信には適用し得ないという不具合があった。

【0009】本発明は上記のような実情に鑑みてなされたもので、その目的とするところは、空間ダイバシティを採用した、より高速なデータ通信にも適用可能な、周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置を提供することにある。

【0010】

【課題を解決するための手段】請求項1記載の発明は、周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、複数のアンテナと、これら複数のアンテナそれぞれにより上記周波数ホッピングされた全周波数でのスペクトル拡散信号を受信すると共に、その電界強度を測定する予備受信手段と、上記周波数ホッピングによる全周波数帯域を複数に分割し、分割した周波数帯域毎に上記予備受信手段で測定した電界強度に基づいて上記複数のアンテナのいずれかを選択判断する判断手段と、この判断手段での判断結果に基づき、到来信号をその周波数に対応して選択したアンテナで受信させるアンテナ切換手段とを具備したことを特徴とする。

【0011】このような構成とすれば、広帯域にわたる伝送方式である周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、複数のアンテナそれぞれの伝搬路特性に対応し、アンテナの切換動作をより少なくて、少しでも高速なデータ通信にも適用可

能としながら、周波数ホッピング方式がそもそも周波数ダイバシティ効果を有していることに加えて、空間ダイバシティによって受信状態のよいアンテナを選択して受信させることができる。

【0012】請求項2記載の発明は、周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、複数のアンテナと、これら複数のアンテナそれぞれにより上記周波数ホッピングされた全周波数でのスペクトル拡散信号を受信すると共に、その電界強度を測定する予備受信手段と、この予備受信手段での受信により、全周波数中、所定の閾値を上回る電界強度が得られた数がより多かったアンテナを選択判断する判断手段と、この判断手段での判断結果に基づいて選択したアンテナで到來信号を受信させるアンテナ切換手段とを具備したことを特徴とする。

【0013】このような構成とすれば、広帯域にわたる伝送方式である周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、複数のアンテナそれぞれの伝搬路特性に対応し、アンテナの切換動作をより少なくして、より高速なデータ通信にも適用可能としながら、周波数ホッピング方式がそもそも周波数ダイバシティ効果を有していることに加えて、空間ダイバシティによって受信状態のよいアンテナを選択して受信させることができる。

【0014】請求項3記載の発明は、上記請求項2記載の発明において、上記判断手段は、複数段階の閾値を用いてより受信状態のよいアンテナを選択判断することを特徴とする。

【0015】このような構成とすれば、上記請求項2記載の発明の作用に加えて、閾値の設定の仕方によって、最低限通信が可能であればよい場合や、より高品位で雑音の少ない信号の通信を行ないたい場合など、必要なレベルに応じた最適な通信環境を設定できる。

【0016】

【発明の実施の形態】(第1の実施の形態)以下本発明を例えればBluetooth(IEEE802.11標準を基本とした無線LAN技術。以下「ブルートゥース」と称する)に準拠した周波数ホッピング方式のスペクトル拡散信号を受信する受信装置に適用した場合の第1の実施の形態について図面を参照して説明する。

【0017】図1はその受信系の回路構成の一部を示すもので、11A、11Bが空間ダイバシティのための2つのアンテナである。これらアンテナ11A、11Bでそれぞれ受信した2.45 [MHz] のISM(Industrial Scientific Medical)帯の信号は、切換部12によりそのいずれか一方のみが選択されて、ここでは図示しない復調系の回路に送られ、逆拡散等の処理が施されて復調される一方、受信電力検出部13にも送られる。

【0018】この受信電力検出部13は、切換部12を

介して送られてくるアンテナ11Aまたは11Bでの受信信号の電界強度を電力レベルの値として検出し、検出結果を制御部14に出力する。

【0019】制御部14は、CPUとその動作プログラムを記憶したROM、ワークメモリとしてのRAM等から構成され、この受信装置全体の動作制御を司るもので、上記切換部12にアンテナ11A、11Bのいずれか一方を切換選択する制御信号を送出する他、受信電力検出部13から受ける受信信号の電力レベルを、上記復調系の回路から送られてくるホッピング周波数を示す受信周波数情報と対にして記憶部15に記憶させ、この記憶部15に記憶させた内容に基づいて選択すべきアンテナを判断する。

【0020】次に上記実施の形態の動作について説明する。

【0021】図2は制御部14により所定時間毎に実行される、空間ダイバシティの動作処理内容を示すものである。同図で、その処理当初には、まず切換部12でアンテナ11Aを切換選択した状態で連続してホッピング周波数1シーケンス(ホッピング幅1 [MHz] のチャネル周波数79個)分の信号を受信させ、それぞれ受信電力検出部13で得られる受信信号の電力レベルをその受信周波数情報と対にしてアンテナ11Aでの受信特性として記憶部15に記憶させる(ステップA01)。

【0022】次に、今度は切換部12でアンテナ11Bを切換選択した状態で同様に連続してホッピング周波数1シーケンス分の信号を受信させ、それぞれ受信電力検出部13で得られる受信信号の電力レベルをその受信周波数情報と対にしてアンテナ11Bでの受信特性として記憶部15に記憶させる(ステップA02)。

【0023】図3(1)は上記アンテナ11Aの受信環境を表わす伝搬路特性を例示するもので、このような伝搬路特性で1シーケンス分の信号を受信すると、受信した各信号の電力レベルは図3(3)に示すようなものとなる。

【0024】同様に、図3(2)は上記アンテナ11Bの受信環境を表わす伝搬路特性を例示するもので、このような伝搬路特性で1シーケンス分の信号を受信すると、受信した各信号の電力レベルは図3(4)に示すようなものとなる。

【0025】ここでは、例えはホッピング周波数の1シーケンスに渡る周波数範囲を図3(3)、(4)に示すように略均等に3つのブロック(周波数帯)に分割するものとすると、上記のようにして2つのアンテナ11A、11Bそれぞれの全周波数範囲に渡る受信信号のレベル検出を行なった後、まずブロックを表わす変数nに初期値「1」を代入した上で(ステップA03)、そのブロック1においてアンテナ11Aで受信した信号の電力レベルとアンテナ11Bで受信した信号の電力レベルのいずれかが相対的に高いかを比較判断する(ステップA

04)。

【0026】ここで、アンテナ11Aで受信した信号の電力レベルがアンテナ11Bで受信した信号の電力レベルに比して相対的に高いと判断した場合には、このブロック1に関してはアンテナ11Aの方が受信状態が良いものとしてブロック1に対応してアンテナ11Aを示す識別信号を記憶部15に記憶設定させる(ステップA05)。

【0027】また反対に、アンテナ11Bで受信した信号の電力レベルがアンテナ11Aで受信した信号の電力レベルに比して相対的に高いと判断した場合には、このブロック1に関してはアンテナ11Bの方が受信状態が良いものとしてブロック1に対応してアンテナ11Bを示す識別信号を記憶部15に記憶設定させる(ステップA06)。

【0028】こうして、ステップA05、A06のいずれか一方の設定処理を終了した後、ブロックを表わす変数nの値を「+1」更新設定し(ステップA07)、更新設定した値がホッピング周波数の1シーケンスに渡る周波数範囲を分割したブロック(周波数帯)の総数Nを越えていないことを確認した上で(ステップA08)、この更新設定した変数nを用いて再びステップS04からの処理を繰返す。

【0029】こうしてステップA04～A08の処理を繰返し実行することにより、残るブロックに関してはより受信状態の良い方のアンテナを識別する情報を記憶部15に記憶設定する。

【0030】そして、分割したすべてのブロックに関しての設定処理を終え、ステップA08においてさらに更新設定した変数nの値がブロックの総数Nを越えていると判断すると、以後記憶部15に記憶設定したブロックとアンテナの識別情報とに従ってホッピング周波数に対応したアンテナを切換選択するように必要により切換部12に制御信号を送信し、ブロック毎により受信状態の良いアンテナを選択して受信を実行させながら(ステップA09)、この記憶部15に設定したアンテナの識別情報に基づいたアンテナ切換えを行なうようにして時間が経過するのを待機し(ステップA10)、経過したと判断した時点で、再び上記ステップA01からの処理に戻る。

【0031】このように、2本のアンテナ11A、11Bそれぞれの伝搬路特性に対応し、分割した周波数帯のブロック毎に適したアンテナを切換選択するようにしたので、同一の周波数帯のブロック内であれば比較的のアンテナの伝搬路特性に似通っている可能性が多いため、周波数毎に切換え動作を行なう場合に比してもアンテナの切換えの動作を少なくすることが可能となり、より高速なデータ通信にも対応しながら、受信状態のよいアンテナを選択して受信させることができる。

【0032】なお、この実施の形態においては、説明を

容易にするためにホッピング周波数の全帯域を分割するブロック(周波数帯)の数が3であるものとしたが、本発明はこれに限ることなく、ホッピング周波数のステップ幅と全周波数チャネルの数等に応じて適宜設定することができる。

【0033】(第2の実施の形態)以下本発明を例えればブルートゥースに準拠した周波数ホッピング方式のスペクトル拡散信号を受信する受信装置に適用した場合の第2の実施の形態について図面を参照して説明する。

【0034】なお、基本的な受信系の回路構成については上記図1で示したものと同様であるものとして、同一部分には同一符号を用いるものとし、その図示及び説明は省略する。

【0035】次に上記実施の形態の動作について説明する。

【0036】図4は制御部14により所定時間毎に実行される、空間ダイバシティの動作処理内容を示すものである。同図で、その処理当初には、まず切換部12でアンテナ11Aを切換選択した状態で連続してホッピング周波数1シーケンス(ホッピング幅1[MHz]のチャネル周波数79個)分の信号を受信させ、それぞれ受信電力検出部13で得られる受信信号の電力レベルをその受信周波数情報と対にしてアンテナ11Aでの受信特性として記憶部15に記憶させる(ステップB01)。

【0037】次に、今度は切換部12でアンテナ11Bを切換選択した状態で同様に連続してホッピング周波数1シーケンス分の信号を受信させ、それぞれ受信電力検出部13で得られる受信信号の電力レベルをその受信周波数情報と対にしてアンテナ11Bでの受信特性として記憶部15に記憶させる(ステップB02)。

【0038】図5(1)は上記アンテナ11Aの受信環境を表わす伝搬路特性を例示するもので、このような伝搬路特性で1シーケンス分の信号を受信すると、受信した各信号の電力レベルは図5(3)に示すようなものとなる。

【0039】同様に、図5(2)は上記アンテナ11Bの受信環境を表わす伝搬路特性を例示するもので、このような伝搬路特性で1シーケンス分の信号を受信すると、受信した各信号の電力レベルは図5(4)に示すようなものとなる。

【0040】ここで、例えば受信した信号の電力レベルの閾値が図5(3)、(4)中にThで示すようなものであったとすると、特にアンテナ11Aで受信した1シーケンス分の信号のうち、2個のチャネル周波数での電力レベルが上記閾値Thを下回っていることがわかる。

【0041】しかるに、制御部14ではアンテナ11Aで受信した1シーケンス分の信号とアンテナ11Bで受信した同信号のそれぞれに対し、上記閾値Thを越えたものがいくつあるかその数を計測するもので(ステップ

B03)、その計測結果に基づいて、2つのアンテナ11A、11Bのいずれがより受信状態が良いのかを、例えばアンテナ11Aで受信した受信信号で上記閾値Thを越えた数がアンテナ11Bで受信した同数より多いか否かで判断する(ステップB04)。

【0042】ここで、アンテナ11Aで受信した受信信号で上記閾値Thを越えた数の方が多いと判断した場合には、アンテナ11Aの方がアンテナ11Bよりも受信状態が良いものとして切換部12に制御信号を送出し、このアンテナ11Aを選択するものとする。

【0043】反対に、アンテナ11Bで受信した受信信号で上記閾値Thを越えた数の方が多いと判断した場合には、アンテナ11Bの方がアンテナ11Aよりも受信状態が良いものとして切換部12に制御信号を送出し、このアンテナ11Bを選択するものとする。

【0044】しかし、上記ステップB05またはB06で選択したアンテナ11Aまたは11Bを用いて、より受信状態の良いアンテナによる受信を実行させながら(ステップB07)、所定の時間が経過するのを待機し(ステップB08)、経過したと判断した時点で、再び上記ステップB01からの処理に戻る。

【0045】このように、2本のアンテナ11A、11Bそれぞれの伝搬路特性に対応し、予め設定した閾値Thを越えるような電力レベルの信号をより多く受けられるアンテナを切換選択するようにしたので、極力アンテナの切換え設定動作を抑えてより高速なデータ通信にも対応しながら、受信状態のよいアンテナを選択して受信させることができる。

【0046】なお、上記実施の形態では、予め設定する閾値を1つであるものとして説明したが、本発明はこれに限らず、複数段階の閾値を予め設定し、例えば最低限通信が可能であるレベルと、より高品位で雑音の少ない信号の送受を行ないたいレベルなど複数のレベルを設定し、送受する信号の内容に応じて最適な通信環境を提供することも可能となる。

【0047】また、上記図1で示した構成では空間ダイバシティシステムを構成するために2本のアンテナ11A、11Bを有するものとして説明したが、これも2本に限ることではなく、3本あるいはそれ以上であっても良い。

【0048】さらに、本発明の第1及び第2の実施の形態はいずれも、ブルートゥースに準拠した周波数ホッピング方式のスペクトル拡散信号を受信する受信装置に適用した場合について説明したものであるが、本発明はこれに限ることもなく、周波数ホッピング方式のスペクト

ル拡散信号を受信するような移動体通信装置で、複数のアンテナにより空間ダイバシティ方式を構築するようなものであれば、いずれにも適用可能であることは勿論である。

【0049】その他、本発明はその要旨を逸脱しない範囲内で種々変形して実施することが可能であるものとする。

#### 【0050】

【発明の効果】請求項1記載の発明によれば、広帯域にわたる伝送方式である周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、複数のアンテナそれぞれの伝搬路特性に対応し、アンテナの切換動作をより少なくしてより高速なデータ通信にも適用可能ながら、受信状態のよいアンテナを選択して受信させることができる。

【0051】請求項2記載の発明によれば、広帯域にわたる伝送方式である周波数ホッピング方式のスペクトル拡散信号を受信する移動通信装置において、複数のアンテナそれぞれの伝搬路特性に対応し、アンテナの切換動作をより少なくしてより高速なデータ通信にも適用可能ながら、受信状態のよいアンテナを選択して受信させることができる。

【0052】請求項3記載の発明によれば、上記請求項2記載の発明の効果に加えて、閾値の設定の仕方によって、最低限通信が可能であればよい場合や、より高品位で雑音の少ない信号の通信を行ないたい場合など、必要なレベルに応じた最適な通信環境を設定できる。

#### 【図面の簡単な説明】

【図1】本発明の第1の実施の形態に係る回路構成を示すブロック図。

【図2】同実施の形態に係る空間ダイバシティの処理内容を示すフローチャート。

【図3】同実施の形態に係る動作を説明する図。

【図4】本発明の第2の実施の形態に係る空間ダイバシティの処理内容を示すフローチャート。

【図5】同実施の形態に係る動作を説明する図。

【図6】周波数ホッピング方式のスペクトル拡散信号を説明するための図。

#### 【符号の説明】

11A、11B…アンテナ

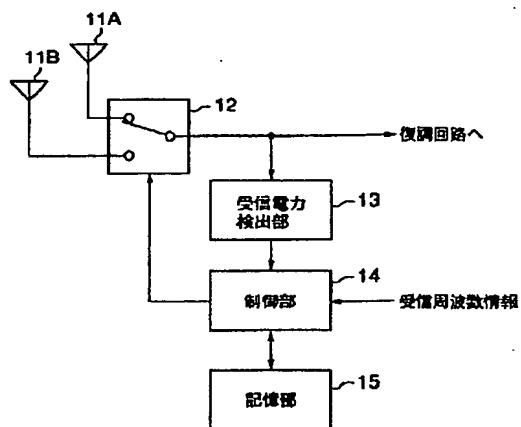
12…切換部

13…受信電力検出部

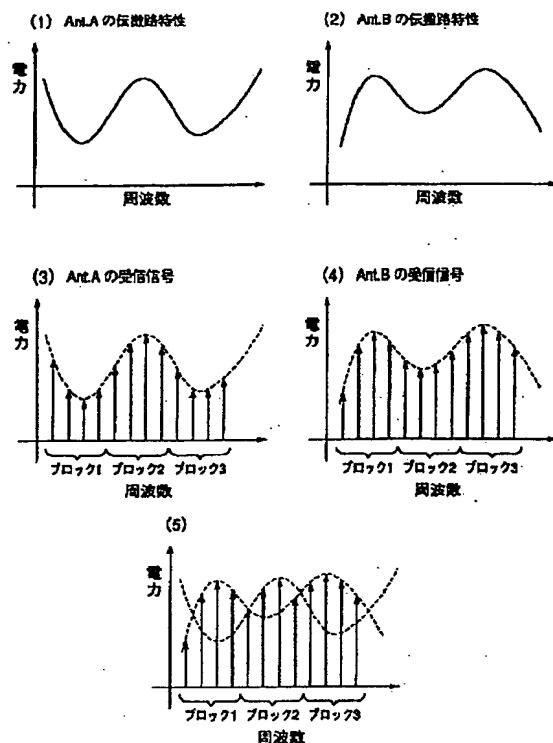
14…制御部

15…記憶部

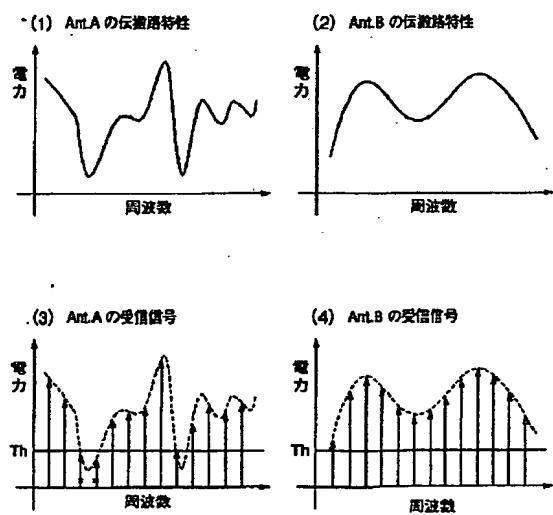
【図1】



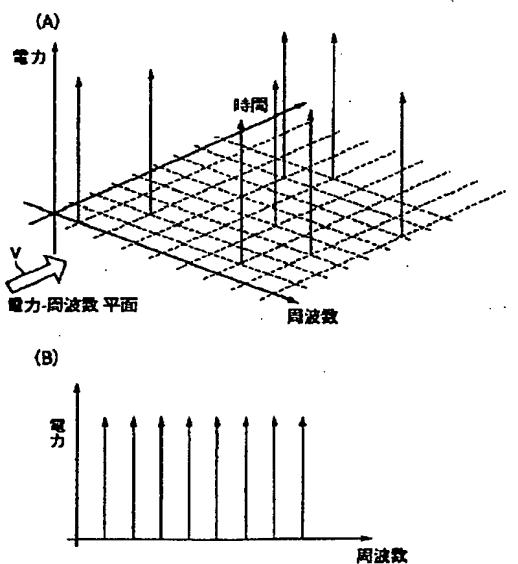
【図3】



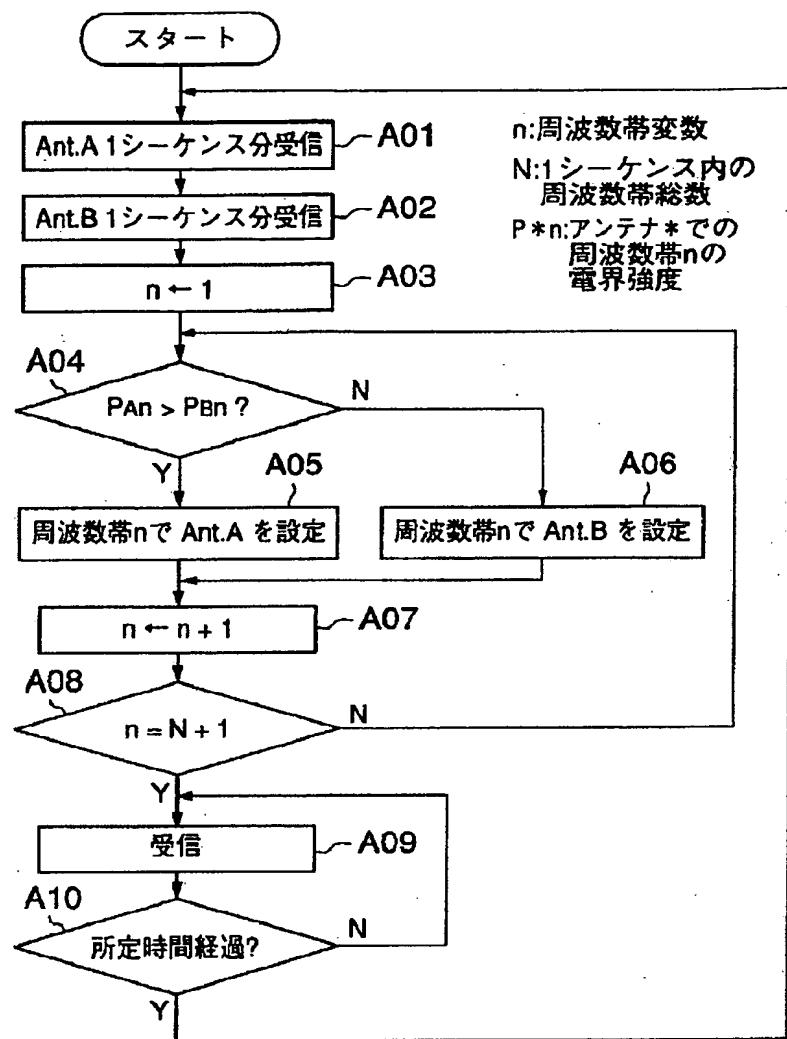
【図5】



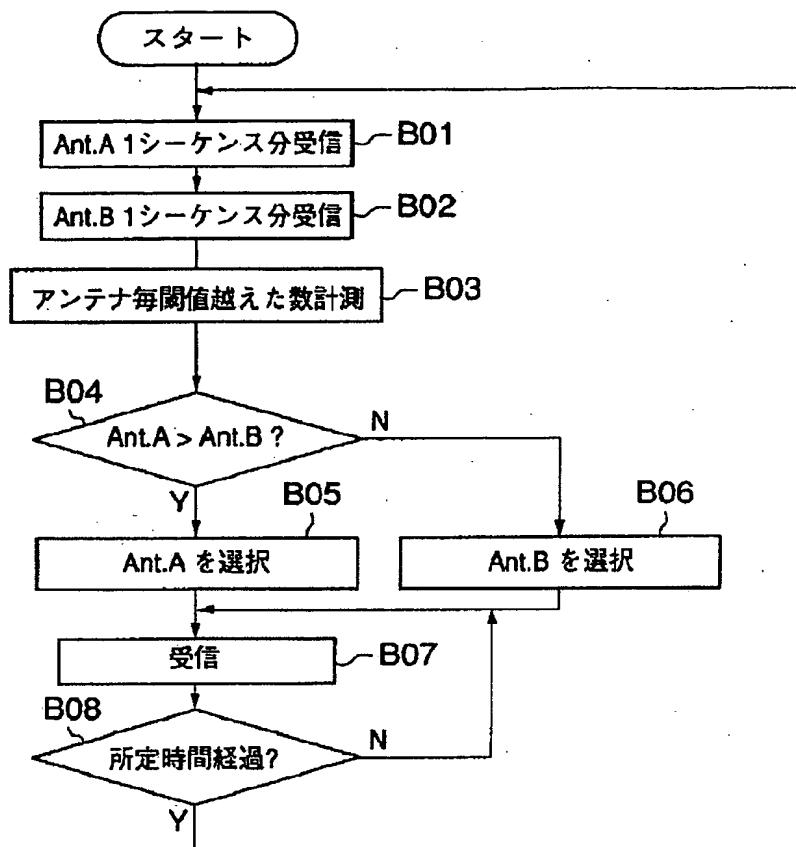
【図6】



【図2】



【図4】




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フロントページの続き

F ターム(参考) 5J021 AA02 AA05 AA06 CA06 DB04  
 FA31 GA02 HA05 HA10 JA03  
 5K022 EE04 EE11 EE31  
 5K059 CC03 DD02 DD07 DD27 EE02  
 5K067 AA23 BB02 CC10 CC24 EE02  
 FF16 GG11 KK03